



PUTTING RESEARCH TO WORK

BRIEF

Better Binder Selection Procedures for Wisconsin Superpave Mixes

One virtue of the Superpave pavement design system is its use of performance graded binders, which are selected based on the temperatures, traffic volumes, and traffic speeds the pavement is expected to experience. PG binders are identified according to pavement temperatures; for example, grade PG 64-22 will sustain desired properties up to an average seven-day maximum pavement temperature of 64°C and a low pavement temperature of -22°C. When WisDOT implemented PG binder specifications—AASHTO MP1—in 1997, the department chose to employ one standard binder grade, PG 58-28, because it was similar to asphalt binders previously used throughout the state.

What's the Problem?

With several climatic regions, including areas that experience low temperatures well below -28°C, Wisconsin would likely benefit from using additional PG binders. Wisconsin can be divided into three climatic regions based on average low temperatures; PGs 58-28, 58-34, and 58-40 would be appropriate for these three regions. High temperatures vary less across the state. PG binders of 52-xx and 58-xx would likely work well for the two high-temperature regions; the 58-xx grade would be appropriate for most of the state, so using this grade throughout would simplify binder selection. For high-volume roads, PG 64-xx or PG 70-xx could be specified to account for the effects of heavy truck traffic and/or slow traffic speeds.

In addition, agencies around the country have found critical gaps in the PG grading system, most of which are somewhat related to the use of modified binders—the existing grading system cannot discriminate between more and less effective modification technologies. To address this problem, NCHRP Report 459 provided a system for evaluating binders based on damage behavior using tests for rutting, fatigue, glass transition temperature, and workability. But the report's conceptual approach lacked the details required for implementation, such as selection criteria and limits. These details could help WisDOT develop a mechanistic procedure for anticipating rutting behavior of binders under speed and traffic volume stress.

Research Objectives and Methodology

By outlining implementation guidelines for the system developed in NCHRP Report 459, this research will allow WisDOT to take full advantage of the Superpave PG grading system by selecting different binders—both modified and unmodified—for local conditions.

The first phase of the research entailed gathering data on climate, traffic, and types of binders used in Wisconsin, as well as reviewing WisDOT's existing guidelines for selecting PG binders based on temperature conditions, traffic volume and speed, and pavement structure.

The second phase, the pith of the research, was laboratory testing of the effect of modifiers on binders in a manner that simulates Wisconsin field conditions, including pavement temperature and traffic conditions. Investigators tested one base asphalt and 18 modified binders; all binders tested are either used or have the potential to be used in Wisconsin. The tests followed Superpave testing protocols and the modifications to the protocols suggested in NCHRP Report 459.

In the final stage of the research, investigators derived specification limits for specific climate and traffic conditions in Wisconsin.

Results

This research developed guidelines for selecting asphalt binders according to expected pavement temperatures, pavement structure, and expected traffic conditions. The specifications include:

- Direct consideration of traffic speed and volume in rutting evaluation of binders through a new test

Investigator



"Current Superpave specifications do not relate very well to the performance of modified asphalts in the field. This study is a step toward correcting that."

—Hussain Bahia

University of
Wisconsin—Madison
bahia@engr.wisc.edu

Project Manager



"This study has a lot of potential to extend the performance lives of roadways. It offers new techniques for evaluating modified binders, a weak spot in the current system."

—Tom Brokaw

WisDOT Bureau of
Project Development
thomas.brokaw@
dot.state.wi.us

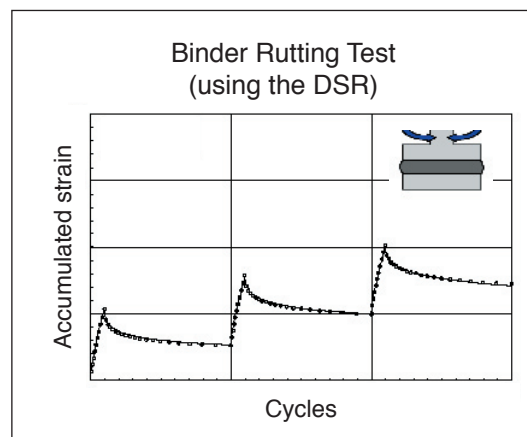
Co-investigators:

Kitae Nam,
Rodrigo Delgadillo,
University of
Wisconsin–Madison

Brief prepared by
CTC & Associates LLC
ctcandassociates.com



By improving guidelines for selecting performance graded binders, this study will help WisDOT build even better, longer lasting asphalt pavements. At right, a new test developed in this research uses a dynamic shear rheometer to measure the elastic recovery of an asphalt sample under cyclic loading. At top right, a schematic drawing shows a layer of asphalt (dark gray) between the two plates of the DSR.



called creep and recovery. This test examines the elastic recovery of a deformation, which can be significant for modified binders. This mechanistic procedure could replace the practice of grade bumping, which accounts for traffic speed and volume by shifting the high temperature grade of the binder.

- Fatigue evaluation of binders based on pavement structure, traffic speed and volume, and normal and thaw seasons. Including two seasons allows direct evaluation of the influence of temperature and the loss of support during the thaw season on the fatigue life of pavements.
- Consideration of shear rate effect in determining proper mixing and compaction temperatures for all binders; this significantly improves construction procedures for very viscous modified binders.

Researchers identified the Particulate Additive Test as a useful tool in evaluating the presence of particulates in modified binders, and recommend that WisDOT incorporate it in future specifications. They also examined the Laboratory Asphalt Stability Test, which can be used to evaluate binder storage stability. Because it is complex and time-consuming, this test is not recommended for inclusion in WisDOT specifications. However, researchers recommend that asphalt suppliers use this test to evaluate possible separation of modifiers and binders during storage.

Further Research

Field evaluation of the binder selection guidelines and specification limits developed in this study is a critical next step. WisDOT Research Project 0092-03-13, "Field Validation of Wisconsin Modified Binder Selection Guidelines," is testing these findings in the field; the study is expected to be complete in July 2006.

Implementation and Benefits

If field study confirms these findings and the ability of WisDOT and contractors to employ them, these guidelines will be incorporated in new specifications for PG binders. These improved specifications will provide a more refined binder selection process, offering Wisconsin pavement designers more options for tailoring asphalt binders to varying temperature and traffic conditions. More cost-efficient asphalt pavements exhibiting longer fatigue lives and better rutting performance should result.

This brief summarizes Project 0092-01-01, "Development of Guidelines for PG Binder Selection for Wisconsin," produced through the Wisconsin Highway Research Program for the Wisconsin Department of Transportation Research, Development & Technology Transfer Program, 4802 Sheboygan Ave., Madison, WI 53707.

Nina McLawhorn, Research Administrator